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Campsurus notatus (Polymitarcidae, Ephemeroptera), a bioturbator in várzea lakes

by

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Abstract

The Neotropical mayfly *Campsurus notatus*, occurs abundantly in várzea lakes, requiring about three months for its aquatic development. Contrary to other suggestions its aquatic instars are shown to be sediment feeders. The nymphs burrow continuously in the loose sediment without building stable tubes. This organism is therefore an important agent for bioturbation and consequently for chemical exchange at the sediment/water interface.

Keywords: *Campsurus notatus*, **bioturbation, várzea lakes.**

Resumo

Camposurus lineatus é um efemeróptero neotropical que ocorre, em abundância, nos lagos de várzea e que necessita aproximadamente de três meses para o seu desenvolvimento. Contrário a outras sugestões, os seus estágios aquáticos alimentam-se de sedimentos. As ninfas cavam continuadamente no sedimento disperso sem construir tubos estáveis. Por isso, este organismo é um agente importante para bioturbações e, conseqüentemente, para o fluxo químico na faixa de contato sedimento/água nos lagos de várzea.

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Introduction

The neogaeic genus *Campsurus* EATON extends from the Tropics to Texas (EDMUNDS et al. 1976) but *C. notatus* is only known from the southern hemisphere (HUBBARD & PETERS 1981). NEEDHAM & MURPHEY (1924) described this species from the whitewater Rio Paraguay, and it is also well known from várzea lakes (e. g. FITTKAU et al. 1975; IRMLER 1975; REISS 1976). Unusually, nymphs of *C. notatus* attain high abundances in the benthos of várzea lakes while other larger metazoans remain rare. Although very little is known about the biology of this mayfly; occasional observations on its gut contents (IRMLER 1975; REISS 1976) are known.

Material

The present observations were made in the várzea near Manaus, during studies into small water colonization (NOLTE 1986). 5 - 10 mm deep layers of cleaned Solimões sediment (av. 0.1 mm grain size = silt), the natural substratum for *C. notatus*, were exposed in petri-dishes (58 cm^2 surface area) on the bottom of experimental pools. In two series of experiments 40 siltfilled dishes were used. Samples were removed at intervals over a period of three months, by placing lids over the dishes and then slowly lifting them out of the water. This allowed undamaged samples of substrata to be examined before fixation.

Because *C. notatus* was an abundant colonizer of the pools in the várzea, material was also cultured in the laboratory. To determine its usual food source, 41 nymphs from field samples (instars between 1 to 20 mm in length) were dissected and their gut contents examined by light microscopy. Even though the cultures were not very successful (all cultures developed fungal growth after a few weeks) the burrowing behaviour of *C. notatus* could be studied with a binocular microscope.

Results

During the field-experiments *Campsurus notatus* occurred with maximum densities of 16,700 to 16,900 ind./m^2 on silt. The other exposed substrata were less densely colonized (see NOLTE 1986). After two months, when the oldest nymphs had grown to ca. 8 mm, these high initial peaks had decreased to ca. 1,300 ind./m^2, although nymphs continued to hatch. Predators of *C. notatus* were absent from the pools. After 89 days the largest nymphs were 23 mm long, and the distinct wing sheath indicated that they represented one of the last aquatic instars. Over a three month period the mean densities of *C. notatus* over the entire pool bottom were about 1,200 to 1,750 ind./m^2 (2 series with 3 parallels).

In none of the 40 inspected petri-dishes was any sign of stable tubes or silk-coated ducts found. *C. notatus* burrows through the loose substratum but only the older nymphs occasionally left slight traces of silk in the back part of their burrows. Under a binocular microscope the movement of *C. notatus* through the substratum could be traced by the trickling silt grains; i. e. burrowing nymphs keep the sediment moving.

In addition to amorphous detritus, and in some case leaf debries, guts contained considerable amounts of mineral material. The proportion of organic to mineral material varied from sample to sample; in five nymphs (total = 41) the guts were entirely empty.

Discussion

It is clear from its high abundance that *C. notatus* is ecologically important in várzea lakes. Only two previous studies have given quantitative data: MARLIER (1967) recorded a maximum density of 684 ind./m^2 in Lago Redondo, which is similar to IRMLER's (1975) value of 800 ind./m^2 on Ilha Curarí during the inundation period in várzea forests. The mean nymph densities in the pools were about twice as high. This is primarily due to the enormous initial peaks, so-called overshoots (MARGALEF 1968) at the start of primary colonization, and the inclusion of even the youngest nymphs (≤ 0.75 mm) in counts. These are often lost in grab-samples (e. g. IRMLER 1975). Furthermore predator pressure was lacking in the pools (see NOLTE 1986); at times some várzean fish species exert strong pressure on *Campsurus* (pers. comm. local people).

Almost nothing is known about the life history of *Campsurus* species (cf. EDMUNDS et al. 1976; HUBBARD & PETERS 1981). The present observations support IRMLER's (1975) suggestion that *C. notatus* requires ten to twelve weeks from egg to emergence, whereas MARLIER (1967) classified all Campsurid nymphs as having an "annual cycle".

Contrary to earlier assumptions *C. notatus* is a sediment feeder. Following SATTLER's (1967) observations on *Asthenopus*, another tropical Polymitarcidae, *C. notatus* was classified as a filter feeder (IRMLER 1975; REISS 1976) or a leaf miner (GEISLER et al. 1975), but the present work revealed that *C. notatus* does not build stable tubes, a basic tenet of SATTLER's (1967) suggestion that possibly all Polymitarcidae are filter feeders. SATTLER (1. c.) gave very detailed description of *Asthenopus* nymphs, which build stable, silk-coated tubes in such a way that the smooth tube wall is closely appressed to the hairy body, thus forcing water through the nymphs filtration apparatus. Referring to SATTLER (1. c.), IRMLER (1975, p. 357) assumed that *C. notatus* was a filter feeder, although he found "clay material and leaf fragments in particular" in its guts. REISS (1976) classified *C. notatus* as a detritophagous filter feeder, but pointed out that a high proportion of clay impairs the filtration rate. In addition to its unstable burrows, and high mineral content of its guts, the available field data on *C. notatus* also contradict the hitherto assumed filter feeding habit. Clay-silt fractions are considerable in várzea lakes, where *C. notatus* often dominates the benthic standing crop (FITTKAU et al. 1975; IRMLER 1976). The whitewater is heavily loaded with suspended material in particular during low water periods (IRION et al. 1984), i. e. September and October, when MARLIER (1967) and IRMLER (1975) recorded the highest abundance and standing crop values for *C. notatus* in the várzea. JUNK (1973) showed that high sediment load is a limiting factor for filter feeders in the floating meadow communities.

Like many burrowing mayflies (cf. EDMUNDS 1979), *C. notatus* is a sediment feeder. The sediment passes through the intestine as in earthworms, and is thus processed by the comparatively large and very abundant nymphs. Therefore this Polymitarcidae is probably an essential, hitherto ignored biogenic factor contributing to the flow of matter between the layer sediment/water. Since the várzea sediments are themselves probably essential for nutrient accumulation and release (FURCH 1984), the role of bioturbation must also be recognised in studies on chemical flow in such biotopes.

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